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EVALUATING STUDENT ANSWERS TO GEOGRAPHY QUESTIONS FRAMED ACCORDING TO THE FACTUAL AND CONCEPTUAL KNOWLEDGE LEVELS OF THE REVISED BLOOM'S TAXONOMY

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Abstract:
The aim of the study was to determine whether there is a relationship between students' answers to geography questions framed according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy. The study used a correlational survey design. The data were gleaned from the answers that 52 students studying social studies teaching at the faculty of education of a state university in the Eastern Black Sea Regions in the 2018-2019 academic year gave to 14 questions framed based on the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy. The data collection instrument designed within the scope of the study was administered to the students twice at a 40-day interval through the test-retest method. The reliability of the measurement instrument was tested using the Pearson product-moment correlation coefficient (PPMCC) and found to be .82. The research hypotheses were tested using the nonparametric chi-square goodness of fit test and chi-square test of independence. First, the frequency and percentage distributions of students' answers to the factual and conceptual questions were computed. The rate of those who answered the factual knowledge questions correctly ranged from 51.9% to 100%, while the rate of those who answered the conceptual knowledge questions correctly ranged from 5.8% to 78.8%. The results of the chi-square goodness of fit test run to test whether students' answers differ in the factual and conceptual knowledge levels showed that there was a statistically significant difference between the observed and expected values [X^2 (1, n = 447) = .0, p = .00]. The results of the chi-square test of independence run to find out whether there is a significant relationship in students' answers to the factual and conceptual knowledge questions showed a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions [X^2(1, n = 447), p = .00, Cramer's V = .24]. These results show that the students were able to give correct answers to the factual knowledge questions that require a basic level of knowledge of geography, while they had difficulty answering the conceptual knowledge questions that require higher-order learning activities and skills. Therefore,

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geography classes should incorporate activities aimed at the upper levels of the knowledge and cognitive process dimensions to help students develop higher-order thinking skills. It is hoped that this study will contribute to further research.

Keywords: revised Bloom's taxonomy, factual knowledge, conceptual knowledge, geography course, geography teaching

1. Introduction

Measurement and evaluation activities serve to determine the extent to which teaching activities are learned and the desired behaviours are acquired. The proper implementation of measurement and evaluation activities is a factor that affects making the right decisions about students.

A variety of criteria such as educational goals, learning outcomes, and students' level should be considered while preparing questions used to evaluate the extent to which what is taught using different teaching strategies (teaching through discovery, teaching through presentation, collaborative teaching, etc.) and techniques (question-answer, discussion, lecture, field trips and observation, demonstration, etc.) is learned. Questions should contribute to the teaching and learning process for teachers and students. Thus, teachers should have sufficient knowledge of measurement and evaluation (Topçu, 2017, p. 321).

Many recent studies have shown that teachers generally carry out assessment and evaluation activities using low cognitive level questions because they are easier to prepare and assess and facilitate keeping the classroom in order and attracting students' attention (Köğce & Baki, 2009, p. 78; Çolak & Demircioğlu, 2010, p. 160; Çalışkan, 2011, p. 128; Tanık & Saraçoğlu, 2011, p. 235; Gökulu, 2015, p. 434; Arseven, Şimşek, & Güden, 2016, p. 243; Şanlı & Pınar, 2017, p. 949).

It has been reported that questions based on factual knowledge along with the cognitive process remember, which mostly help recall and recite previous knowledge, do not contribute much to the development of students' higher-order skills. However, it is more useful to use questions, practices, and activities that improve students' skills and creativity by using higher-order knowledge and cognitive process levels (Kawanaka & Stigler, 1999, pp. 277-278; Topçu, 2017, p. 322; İlhan & Gülersoy, 2019, p. 10; Erdoğan, 2017, p. 187).

Simple and clear measurement and evaluation questions help students become more successful. However, questions should still be of academic quality to contribute to students' cognitive development (Wilen & Clegg, 1986, p. 153; Arslan, 2006, p. 81). When vague and nonacademic questions are addressed to students, the uncertainty as to how to answer leads to a fear of failure. As a result, students get anxious about participating in the class and do not contribute to the formation of appropriate learning environments (Brualdi, 1998, pp. 2-3; Topçu, 2017, p. 322).

There are many taxonomies that serve as a guide in preparing questions used to determine the extent to which learning is achieved. Taxonomies are tools that can be used in curriculum design and in the preparation of measurement and evaluation questions appropriate to the objectives and learning outcomes of a course (Sönmez, 2008, p. 33; Shaunessy, 2000, p. 15; Duman, 2015, p. 23; Ilango-Sivaraman & Krishna, 2015, p. 6; Çelenk, 2016, p. 14). Thus, it is important to make use of a certain taxonomy to formulate questions to ask students in line with the objectives and learning outcomes of a course.

Taxonomy is defined as a stepwise classification of targeted student attitudes moving from simple to complex and from concrete to abstract with one being the prerequisite for the other (Yüksel, 2007, p. 480; Sönmez, 2008, p. 33). There are many taxonomies such as Bloom's Taxonomy, Revised Bloom's Taxonomy, Gerlach and Sullivan's Taxonomy, De Block's Taxonomy, Tuckman's Taxonomy, Williams' Taxonomy, Gagne's Taxonomy, Hauenstein's Cognitive Domain Taxonomy, and Marzano's Taxonomy (Yüksel, 2007, pp. 482-502; Sönmez, 2008, pp. 33-36). Bloom's Taxonomy proposed by Benjamin S. Bloom in 1956 and Revised Bloom's Taxonomy published in 2001 are among the most widely used taxonomies in the classification of educational goals (Bümen, 2010, pp. 3-4; Tutkun, 2012, pp. 15-18).

1.1. Bloom's Taxonomy

According to Bloom, humans begin life with mental properties of learning and have an unlimited learning capacity. Teaching and learning processes show the extent to which learners' properties and limits of learning can be evaluated. Bloom underlines that children can learn everything that is of interest to them when a suitable educational environment is provided. Bloom also notes that learning differences in children arise from individual differences in learning styles, interests, motivations, and learning speeds (Bloom, 2012, pp. 4-5).

In this connection, in 1948, a committee of educators chaired by Bloom was engaged in a task of devising a classification system for the three learning domains, that is cognitive, affective, and psychomotor in relation to educational goals and objectives. Although the committee completed the classification for the cognitive domain in 1956, the affective and psychomotor domains remained unclassified (Huitt, 2009; Tutkun, 2012, p. 15).

1.1.1. Key Features of the Original Bloom's Taxonomy

Bloom's taxonomy presents educators what students should know in a hierarchical manner from simple to complex. Classification levels are successive. Thus, unless a lower level is completed, the next level cannot be taken (Huitt, 2009).

Bloom's original cognitive domain taxonomy consists of the levels of knowledge, comprehension, application, analysis, synthesis, and evaluation. Each level has its sublevels. Comprehension, application, analysis, synthesis, and evaluation are described in stages of abilities and skills (Anderson, et al., 2018, p. 356). In the original Bloom's taxonomy, the levels of knowledge, comprehension and application are aimed at lower-order thinking skills, while analysis, synthesis, and evaluation focus on higher-order thinking skills (Köğce & Baki, 2009, p. 72; Anderson, 2005, p. 104; Table 1).

Table 1: Bloom's Original Taxonomy (Yurdabakan, 2012, p. 329; Huitt, 2009, pp. 2-3)

1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

From 1995 to 1999, a commission of experts chaired by Anderson and Krathwohl undertook the task of revising Bloom's taxonomy. As a result of the efforts of the commission, the original Bloom's taxonomy was revised into the present form in 2001 (Anderson & Krathwohl, 2001, p. 103; Krathwohl, 2002, p. 212; Bümen, 2006, p. 4; Okay & Tutkun, 2012, p. 16).

1.1.2. Grounds for the Revision of the Original Taxonomy

Since 1956, Bloom's taxonomy has been widely used to make a systematic classification for the learning and teaching processes. Developments in education and other fields after 1956 formed the basis for updating Bloom's taxonomy. These developments can be summarized as follows:

1) In the period after 1956, new studies on and philosophical approaches to how learning occurs emerged, thereby creating a need to reconsider and revise educational goals.
2) New insights into learning were constructed, the constructivist learning theory came into sharp focus in education, and Bloom's taxonomy was judged inadequate in measuring metacognitive skills (Özçelik, 2018, p. xx; Bümen, 2006, p. 4).

1.1.3. Revised Bloom's Taxonomy

The intention behind the revised version of Bloom's taxonomy is to facilitate interaction between teachers, curriculum developers, and measurement and evaluation experts. With the revision, Bloom's single-dimension taxonomy was expanded into a two-dimensional model consisting of the cognitive process dimension and the knowledge dimension. The knowledge dimension covers the categories of factual, conceptual, procedural and metacognitive knowledge and is used to refer to the noun (object) forms of learning outcomes. The cognitive process dimension consists of six successive levels associated with mental activities. These levels are remember, understand, apply, analyse, evaluate, and create. The cognitive process dimension is used to express the verb (action) forms of learning outcomes (Table 2).

Table 2: Revised Bloom's Taxonomy (Krathwohl, 2002, p. 216; Tutkun, 2012, p.19)

The Knowledge Dimension	**The Cognitive Process Dimension**					
	1. Remember	**2.** Understand	**3.** Apply	**4.** Analyse	**5.** Evaluate	**6.** Create
A. Factual Knowledge						
B. Conceptual nowledge						
C. Procedural Knowledge						
D. Metacognitive Knowledge						

Knowledge, the first level of the original taxonomy, was replaced by the first level remember in the revised version, the second level comprehension was replaced by understand, and the fifth level synthesis was replaced by evaluate. The revision made the taxonomy more functional (Ayvacı & Türkdoğan, 2010, p. 15; Tutkun, 2012, p. 18). Because this study deals with the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy, it presents an overview of only the knowledge dimension.

1.1.3.1. Knowledge Dimension: It involves the levels of factual, conceptual, procedural and metacognitive knowledge.

a) Factual Knowledge: It covers the attitudes of using, understanding, and communicating knowledge that constitutes the main concepts of any discipline. It is used to express observable, provable or measurable events of nature in general. For example, rain can be observed and the intensity of the wind can be measured. For the factual knowledge level, learners are expected to define and understand the basic concepts and to express the legends and units related to the concepts. Abstraction using basic information is not expected for this level (Ayvacı & Türkdoğan, 2010, p. 15; Yurdabakan, 2012, p. 331). For example, in relation to factual knowledge about the subject of maps, learners should be able to define concepts such as map, scale, and legend and tell what a legend refers to. Examples of factual knowledge include, for example, saying that Turkey is a peninsula surrounded by sea on three sides or Lake Van is the largest lake in Turkey or defining how many types of rainfall there are. Factual knowledge is divided into two subgroups: knowledge of terminology and knowledge of specific detail and elements.

b) Conceptual Knowledge: It is the level at which relations between concepts are established and classifications and generalizations are made. Theories, diagrams, charts, maps, models, and tables can be used to comment on the relationship between different conditions relating to a subject (Ayvacı & Türkdoğan, 2010, p. 15). With respect to soil formation, for example, learners should not focus solely on climate processes but to think in a way that takes into account the effects of elevation, exposure, slope, and direction of mountains on soil formation. Conceptual knowledge is divided into three subgroups: knowledge of classifications and categories, knowledge of principles and generalizations, and knowledge of theories, models, and structures.

c) Procedural Knowledge: It covers the criteria for how to solve any problem and how to use research methods, skills, algorithms, techniques, and methods in this process

(Anderson, et al., 2018, p. 37; Lauritzen, 2012, pp. 17-18). For example, it is concerned with factual knowledge to learn the concepts of map and scale and with conceptual knowledge to reach specific details about the map by connecting the concepts of map and scale, while it is concerned with procedural knowledge to calculate the real distance between the two points on the map using the scale. Procedural knowledge also involves procedures such as calculating the arithmetic population density of a country or region, creating profiles using topography maps, calculating the difference in elevation, and calculating scales and areas. Procedural knowledge is divided into three subgroups: knowledge of subject-specific skills and algorithms, knowledge of subject-specific techniques and methods, and knowledge of criteria for determining when to use appropriate procedures (Anderson, et al., 2018, p. 37).

d) Metacognitive Knowledge: It generally refers to the awareness and knowledge of one's own cognition. The more learning occurs, the greater interest and awareness learners have. Metacognitive knowledge involves the control and regulation of knowledge aside from the knowledge of knowledge. Metacognitive knowledge is divided into three subgroups: strategic knowledge, knowledge about cognitive tasks, and self-knowledge (Yüksel, 2007, p. 501). An example of metacognitive knowledge is the awareness of the capability to explain the relationship between internal and external forces and the formation of landforms in the geography class.

1.2. Objective of the Study

The study aimed to determine whether there is a relationship between students' answers to geography questions framed according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy.

1.3 Significance of the Study

The analysis of questions prepared for geography teaching in line with the Revised Bloom's Taxonomy is of major importance for gaining insight into the knowledge and cognitive process dimensions of learning outcomes. In addition to providing data for further research, this study contributes to the teaching of factual and conceptual knowledge and measurement and evaluation practices in geography classes.

1.4 Scope and Limitation of the Study

The students were asked to answer 14 questions which were dealing with the subjects of population and settlement covered in the general human and economic geography course and framed according to the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy. The study is thus limited to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy.

1.5 Research Questions

The study sought an answer to the question "Is there a relationship between students' answers to geography questions framed according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy?".

Subquestions:

1) Is there a difference between the frequency and percentage values of students' answers to the factual knowledge questions and conceptual knowledge questions?
2) Do students' answers to the questions differ in the factual and conceptual knowledge levels?
3) Is there a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions?

2. Literature Review

There is very little published research in Turkey that examines exam questions prepared for geography teaching in relation to the Revised Bloom's Taxonomy (Akpınar, 2003; Aydoğan, 2008; Geçit & Yarar, 2010; Sönmez, Koç, & Çiftçi, 2013; Arseven et al., 2016). It is thus hoped that the study will contribute to the literature.

Akpınar (2003) examined the exam questions prepared by geography teachers in secondary schools in terms of cognitive levels. He analysed 1239 questions from 120 written geography exams conducted in secondary schools in Erzincan (Turkey) in the 2001-2002 academic year according to the original Bloom's taxonomy. He found that almost half of the questions (48%) were aimed at the knowledge level, very few questions (9%) were designed to measure higher-order learning outcomes specified in the geography curriculum. He emphasized that this is a major problem that undermines the validity of geography course exams.

One of the prominent studies on the issue in Turkey is a master's thesis completed by Aydoğan in 2008, who analysed the geography questions asked in the high school placement exams in Turkey from 2003 to 2007. He classified and examined the geography questions for their congruence with the social studies curriculum according to Bloom's cognitive domain taxonomy. As a result of the analysis, he observed that most of the questions were aimed at the comprehension level, while there was no question for the knowledge and evaluation levels. The geography questions in the 2007 high school placement exam had a poor discrimination index with a high degree of difficulty in general. He also highlighted that students made more mistakes in questions involving shapes.

Geçit and Yarar (2010) analysed the questions in the ninth-grade geography coursebook and various geography exam questions according to Bloom's taxonomy. Using Bloom's taxonomy, they classified and comparatively analysed the review questions at the end of each unit of the ninth-grade geography textbooks, the ninth-grade geography exam questions prepared by high school teachers from different cities in Turkey, and the geography questions in the 2008 and 2009 higher education placement exams, which were related to the ninth-grade geography lesson. They found 222 coursebook questions, 233 exam questions framed by teachers, and 11 questions in the placement exams.

As a result of the analysis according to Bloom's taxonomy, they determined that the coursebook questions and the exam questions framed by teachers were mostly aimed at the knowledge level, while the placement exam questions were mostly aimed at the comprehension level. Although a few, questions at the analysis, synthesis and evaluation levels aimed at improving students' higher-order thinking skills were included and distributed in a balanced manner in the placement exam. They also reported that the questions framed by teachers and the end-of-unit questions were not stimulating students' higher-order thinking.

Sönmez et al. (2013) classified and analysed the geography questions in the 2008, 2009, 2010 and 2011 higher education placement exams according to the cognitive process dimension of the Revised Bloom's Taxonomy using document analysis. They found that the geography questions in the placement exams mostly focused on the understand level of the cognitive process dimension. They also reported that although a few, questions relying on the analyse, evaluate and create levels started to be used with the new examination system put into practice in 2010.

Arseven et al. (2016) classified the written geography exam questions prepared by geography teachers according to the cognitive process dimension of the Revised Bloom's Taxonomy. They analysed 1011 questions prepared by geography teachers working in different types of schools in the city centre of Sivas (Turkey) in the 2015-2016 academic year. They found that among the exam questions prepared by geography teachers, 59.6% were aimed at the remember level, 34.5% at the understand level, 4.8% at the apply level, 0.9% at the analyse level and 0.1% at the evaluate level. No question was aimed at measuring the create level. The authors concluded that almost all the written exam questions prepared by geography teachers (98.9%) were rooted in the remember, understand and apply levels compared to the relatively small number of questions rooted in higher-order cognitive process levels (1.1%).

3. Methodology

This study used a correlational survey design. Correlational survey research aims to measure a relationship between two or more variables (Sönmez & Alacapınar, 2016, p. 50; Turan, 2016, p. 64).

3.1. Population, Sample and Sampling Techniques

The population consisted of 52 first-year students studying social studies teaching at the faculty of education of a state university in the Eastern Black Sea Regions in the spring term of the 2018-2019 academic year. The entire population was studied and all students volunteered to participate in the study.

3.2. Research Design

The study used a measurement instrument consisting of 14 questions (10 multiple-choice questions and 4 open-ended questions) developed by the researcher in line with the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy. After the questions were prepared, they were administered to 35 students as a pilot test to measure the comprehensibility of question statements.

In line with their answers, two questions were amended and the 14-question measurement instrument was given its final form. Two geography scholars were consulted during the development phase of the instrument. The first 7 questions in the instrument were aimed at the factual knowledge level with 5 multiple-choice and 2 open-ended questions. The last 7 questions were aimed at the conceptual knowledge level with 5 multiple-choice and 2 open-ended questions.

3.3. Research Instruments

The research data were obtained from the answers that 52 students gave to the 14-question measurement instrument. 14 questions which were addressing the subjects of population and settlement covered in the general human and economic geography course were administered to the students through the test-retest method. The correct answers were encoded as 1, the wrong answers as 2, and the unanswered questions as 3. The instrument was administered to 52 students twice at a 40-day interval.

3.4. Validation and Reliability of the Instruments

The reliability coefficient can be found using the Pearson product-moment correlation coefficient (PPMCC) because the scores obtained by administering the same test to the same group twice at different times are evaluated as continuous variables. Pearson's r has a value between +1 and −1. However, the reliability coefficient does not have a negative (-) value.

The test-retest reliability coefficient has a value between 0 and +1. The closer the correlation coefficient is to +1, the closer the correlation is between the two values; the closer the correlation coefficient is to 0, the weaker the correlation is between the two values (Sönmez & Alacapınar, 2016, p. 132). The reliability of the measurement instrument was tested using PPMCC. The test-retest reliability was computed to be .82 as follows using the formula for Pearson's r:

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

$$r = \frac{178200 - \frac{(2882)(3014)}{52}}{\sqrt{\left(173220 - \frac{(2882)^2}{52}\right)\left(188148 - \frac{(3014)^2}{30}\right)}} = \frac{11154.9}{13471.3} = 0.82804926$$

This value confirms the consistency of the scores obtained from the two administrations of the test, indicating that stable measurements can be made.

3.5. Methods of Data Analysis

1) First, the Kolmogorov-Smirnov test was performed to decide which parametric or nonparametric tests to use. Because the p-value was less than .05 for all variables, the data were not normally distributed. The Kolmogorov-Smirnov test assesses the normality of the distribution of scores and a Sig. value of more than .05 indicates the normality of data (Pallant, 2016, p. 75). Therefore, nonparametric tests were used to test the hypotheses of the study.
2) First, frequency and percentage distributions were determined to find out whether students' answers to the factual and conceptual questions differ.
3) The chi-square goodness of fit test was used to determine whether students' answers differ in the factual and conceptual knowledge levels.
4) The chi-square test of independence was used to analyse students' answers to the question "Is there a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions?".

4. Results

This section involves the analysis of frequency and percentage distributions of students' answers to find out whether students' answers to the factual and conceptual questions differ. It then presents the results of the chi-square goodness of fit test run to examine whether students' answers differ in the factual and conceptual knowledge levels and the chi-square test of independence run to examine whether there is a significant relationship in students' answers to the factual and conceptual knowledge questions.

4.1. Percentage and Frequency Distributions of Students' Answers to the Factual and Conceptual Knowledge Questions

Table 3 and Figure 1 show the percentage and frequency distributions of students' answers to the factual and conceptual knowledge questions.

Table 3: Distribution of Students' Answers to the Questions

Question No	Answer correctly		Answer incorrectly		Do not answer		Total	
	n	%	n	%	n	%	n	%
1.	46	88.5	6	11.5	0	0	52	100.0
2.	34	65.4	18	34.6	0	0	52	100.0
3.	34	65.4	18	34.6	0	0	52	100.0
4.	27	51.9	25	48.1	0	0	52	100.0
5.	52	100.0	0	0	0	0	52	100.0
6.	44	84.6	8	15.4	0	0	52	100.0
7.	37	71.2	15	28.8	0	0	52	100.0
8.	38	73.1	13	25.0	1	1.9	52	100.0
9.	17	32.7	34	65.4	1	1.9	52	100.0
10.	41	78.8	11	21.2	0	0	52	100.0
11.	23	44.3	27	51.9	2	3.8	52	100.0
12.	32	61.6	19	36.5	1	1.9	52	100.0
13.	12	23.1	26	50.0	14	26.9	52	100.0
14.	3	5.8	39	75.0	10	19.2	52	100.0

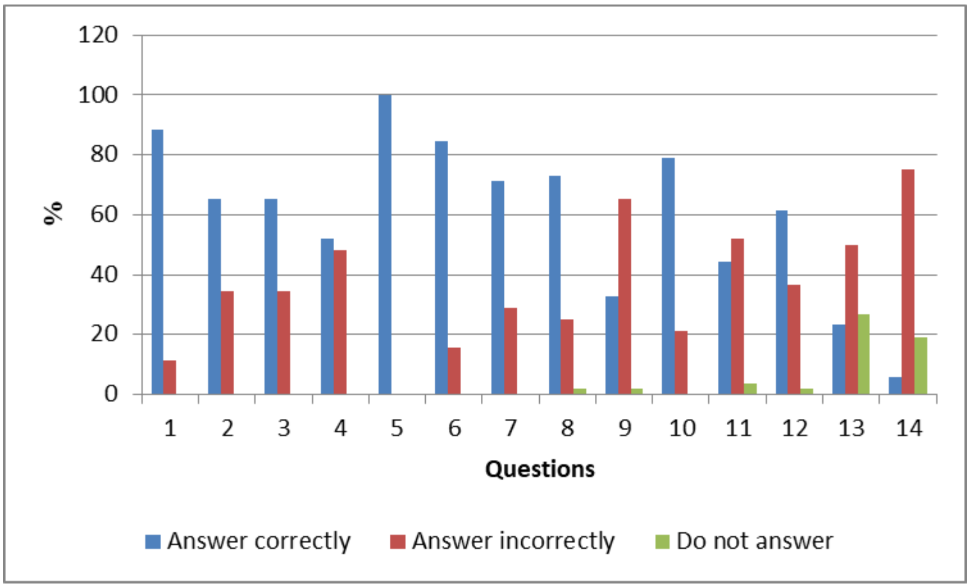

Figure 1: Distribution of Students' Answers to the Questions (%)

The questions 1 to 7 were rooted in the factual knowledge level and the questions 8 to 14 questions were rooted in the conceptual knowledge level. The percentages of the correct answers that the students gave to the factual knowledge questions 1 to 7 to were 88.5%, 64.4%, 65.4%, 51.9%, 100%, 84.6%, and 71.2%, respectively. The percentages of the correct answers that the students gave to the conceptual knowledge questions 8 to 14 to were 73.1%, 32.7%, 78.8%, 44.6%, 61.6%, 23.1%, and 5.8%, respectively (Table 3, Figure 1). The percentages of the correct answers to the open-ended conceptual knowledge questions 13 and 14 were relatively lower.

4.2. Do students' answers to the questions differ in the factual and conceptual knowledge levels?

Tables 4 and 5 show the results of the chi-square goodness of fit test run to test whether students' answers differ in the factual and conceptual knowledge levels.

Table 4: Chi-Square Goodness of Fit Test Crosstabulation

			Conceptual							Total
			1.00	2.00	3.00	4.00	5.00	6.00	7.00	
Factual	1.00	Count	46	34	34	27	52	44	37	274
		Expected Count	51.5	31.3	46.0	31.3	51.5	33.7	28.8	274.0
	2.00	Count	38	17	41	24	32	11	10	173
		Expected Count	32.5	19.7	29.0	19.7	32.5	21.3	18.2	173.0
Total		Count	84	51	75	51	84	55	47	447
		Expected Count	84.0	51.0	75.0	51.0	84.0	55.0	47.0	447.0

Table 5: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.829[a]	6	.000
Likelihood Ratio	26.863	6	.000
Linear-by-Linear Association	11.367	1	.001
N of Valid Cases	447		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.19.			

Tables 4 and 5 show the results of the comparison of the expected and observed values. The results of the chi-square tests show that there is a statistically significant difference between the observed and expected values of students' answers to the factual and conceptual knowledge questions [x2 (1, n = 447) = .0, p = .00].

The degree of freedom (df) is 6. The level of significance of this value is .00. It is presented in the column called Asymp. Sig. (i.e. asymptotic significance) (Table 5). The Sig. value must be 05 or smaller for statistical significance. In the chi-square significance table, the value with df = 6 and p = .05 is 12.5916. The Pearson Chi-Square value is 25.829 (Table 5). This value is greater than the value read from the chi-square significance table, indicating that there is a significant difference between students' answers to the factual knowledge questions and those to the conceptual knowledge questions.

4.3. Is there a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions?

Below are given the results of the chi-square test of independence performed to analyse the answers to the question "Is there a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions?".

The footnote below the Chi-Square Tests table (Table 5) demonstrates whether "*one of the assumptions of chi-square concerning the minimum expected cell frequency which should be 5 or greater*" (Pallant, 2016, p. 239) was violated in this study. In the study, 0 cells (.0%) had expected frequencies less than 5. This result means that the assumption was not violated because all expected cell sizes are greater than 5 (in this study, greater than 18.19) (Table 5).

The summary information provided in the Crosstabulation for Factual and Conceptual Knowledge Questions (Table 6) shows how many students answered each factual and conceptual knowledge question correctly. This information is detailed in Table 3 and Figure 1.

The Adjusted Residual value given for each cell in Table 6 helps determine the differences between groups. Adjusted Residual "*values of more than 2.0 indicate that the number of cases in the cell is significantly larger than expected, and values less than -2.0 suggest the number of cases is less than expected*" (Pallant, 2016, p. 240).

Table 6: Chi-Square Test of Independence Crosstabulation for Factual and Conceptual Knowledge Questions

			Conceptual							
			1.00	**2.00**	**3.00**	**4.00**	**5.00**	**6.00**	**7.00**	**Total**
Factual	1.00	Count	46	34	34	27	52	44	37	274
		% within factual	16.8%	12.4%	12.4%	9.9%	19.0%	16.1%	13.5%	100.0%
		Adjusted Residual	-1.4	.8	-3.1	-1.3	.1	3.0	2.6	
	2.00	Count	38	17	41	24	32	11	10	173
		% within factual	22.0%	9.8%	23.7%	13.9%	18.5%	6.4%	5.8%	100.0%
		Adjusted Residual	1.4	-.8	3.1	1.3	-.1	-3.0	-2.6	
Total		Count	84	51	75	51	84	55	47	447
		% within factual	18.8%	11.4%	16.8%	11.4%	18.8%	12.3%	10.5%	100.0%

The main value of most interest among the outputs is the Pearson Chi-Square value presented in Table 5. This value is 25.829. The degree of freedom (df) is 6. The level of significance of this value is .00 (Table 5). The Sig. value must be 05 or smaller for statistical significance. In this study, the value of .00 is smaller than the alpha value of .05, indicating that there is a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions.

The effect size coefficient ranges from 0 and 1. Higher values indicate a stronger correlation between two variables (Pallant, 2016, p. 241). In this study, the effect size value is .240 (Cramer's V presented in Table 7 is reported because the tables are larger than 2 by 2). Pallant (2016, p. 241) proposes the following effect size values for two categories: small = .01, medium = .30, and large = .50. This value corresponds to a medium effect size according to Cohen's (1988, pp. 5-11) effect size benchmarks (.10 = small effect size, .30 = medium effect size, and .50 = large effect size). The effect size coefficient (Table 7) shows that there is a moderate correlation between the students' answers to the factual knowledge questions and those to the conceptual knowledge questions.

Table 7: Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.240	.000
	Cramer's V	.240	.000
N of Valid Cases		447	

The results of the chi-square test of independence revealed a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions [$X^2(1, n = 447)$, $p = .00$, Cramer's $V = .24$] (Table 8).

5. Discussion

The study set out to determine whether there is a relationship between students' answers to geography questions framed according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy. To this end, the study analysed students' answers to 14 questions which were concerned with the subjects of population and settlement included in the general human and economic geography course in the undergraduate social studies teaching curriculum and framed according to the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy.

A statistically significant difference was found between the observed and expected values in the analysis for the subquestion "Do students' answers to the questions differ in the factual and conceptual knowledge levels?". The fact that the calculated value is greater than the value read from the chi-square significance table suggests a statistically significant relationship between the variables (Bircan, Karagöz, & Kasapoğlu 2003, p. 72). The percentage of correct answers was lower in the conceptual knowledge question compared to the factual knowledge questions. The results of the Chi-Square goodness showed a statistically significant difference between the observed and expected values. Much of the research up to have analysed questions prepared by teachers according to the Revised Bloom's Taxonomy (Akpınar, 2003; Aydoğan, 2008; Balcı, 2002; Çalışkan, 2011; Geçit & Yarar, 2010; Ünlü, 2010; Sönmez et al., 2013; Arseven et al., 2016; Şanlı & Pınar, 2017) rather than analysing students' answers to questions framed based on the Revised Bloom's Taxonomy. It thus makes a meaningful comparison impossible.

Based on the results of the chi-square test of independence conducted to find out whether there is a significant relationship between students' answers to the factual and conceptual knowledge questions, the Pearson Chi-Square value was 25.829 and the degree of freedom (df) was 6. The level of significance of this value is .00 (Table 5). Because the value of .00 is smaller than the alpha value of .05, it means that there is a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions. These results show that the students could give correct answers to the factual knowledge questions that require a basic level of knowledge but had difficulty in answering the conceptual knowledge questions that require associating, interpreting the problem using given figures and graphs, and correctly analysing clues about the problem (Lauritzen, 2012, p. 40; Baki & Kartal, 2004, pp. 32-33; Taboada & Guthrie, 2006, pp. 4-6; Brewer & Brewer, 2010, p. 333).

Analysing exam questions prepared by teachers according to the cognitive process and knowledge dimensions of the Revised Bloom's Taxonomy, previous studies have reported that the majority of questions focus on the factual and conceptual knowledge levels and the remember and understand levels (Akpınar, 2003, p. 19; Arseven et al., 2016, p. 243; Şanlı & Pınar, 2017, p. 957). These studies show that geography teachers are competent to prepare questions relying on the lower levels of the cognitive process and knowledge dimensions of the Revised Bloom's taxonomy but they have a lack of skills and knowledge in the higher levels of the cognitive process and knowledge dimensions that require higher-order learning and practices. The present study found that the number of students who responded correctly to the conceptual knowledge questions was lower than those who answered the factual knowledge questions correctly. This result highlights the need to incorporate practices and activities that improve students' higher-level knowledge and cognitive processes and creativity into the learning environment.

Previous studies on the analysis of questions in other disciplines using the Revised Bloom's Taxonomy have focused more on the analysis of exam questions prepared by teachers than the analysis of students' answers to questions framed according to the Revised Bloom's Taxonomy. What stands out in these studies is that questions mostly focus on the factual and conceptual levels of the knowledge dimension and on the remember and understand levels of the cognitive process dimension (Ayvacı & Türkdoğan, 2010, p. 23; Eroğlu & Kuzu, 2014, p. 72; Koray, Altunçekiç, & Yaman, 2005, p. 33; Yıldız, 2015, p. 479; Korkmaz & Ünsal, 2016, p. 170; Köğce & Baki, 2009, pp. 77-78). The percentage of correct answers to the open-ended conceptual knowledge questions was remarkably lower (Table 3, Figure 1). It depends on learners' higher-order thinking skills such as problem-solving, synthesis and creative and critical thinking to organize and word the answer to an open-ended question (Aydın, 2018, pp.136-137). In the study, the percentage of correct answers was the lowest for the open-ended conceptual knowledge questions (Table 3, Figure 1), thereby suggesting that the students lack knowledge and skills linked to the higher levels of the knowledge and cognitive process dimensions. It is thus of major importance to pay attention to this situation in learning activities. Similar problems are also seen in questions prepared by preservice teachers.

A considerable volume of research has shown that preservice teachers are competent to phrase questions relating to the factual and conceptual knowledge levels of the Revised Bloom's Taxonomy but lack the capability to frame questions relating to the procedural and metacognitive level. Likewise, it has been reported that preservice teachers have the capability to prepare questions rooted in the remember and understand levels of the cognitive process dimension while they lack the competence in preparing questions rooted in the apply, analyse, evaluate and create levels which require higher-order thinking and using previous learning (Koray et al., 2005, p. 33; Aktaş, 2017, pp. 99-100; Yeşilyurt, 2012, p. 519; Mercan, 2019, p. 291; Tüzel, 2013, p. 1086).

Teaching aims to develop skills that foster the transfer of learning. The effective transfer of knowledge and skills to the new situations or the next learning level is linked to the conceptual, procedural and metacognitive levels of the knowledge dimension and the apply, analyse, evaluate create levels of the cognitive process dimension (Anderson & Krathwohl, 2001, p. 158; Karabacak, 2016, p. 148; Senemoğlu, 2015, pp. 383-389; Sönmez, 2008, pp. 37-38; Taşdemir, 2015, p 111). Therefore, learning outcomes and activities in geography course curricula designed for all levels of education should be organized in such a way as to improve students' higher-order knowledge and skills and learning activities should be practised accordingly.

5. Recommendations

- The percentage of correct answers is higher in the factual knowledge questions but decreases in the conceptual knowledge questions, thereby leading to an increase in the difference between the correct answers given to the two types of questions. Students answer factual knowledge questions that contain basic elements that they must know because they find them easy to answer. On the other hand, they have difficulty in answering conceptual knowledge questions that require knowing the interrelationships among the basic elements; thus, a small number of students answer conceptual knowledge questions correctly and even a larger number of students do not answer. Therefore, geography teaching activities should be organized in such a way as to help students answer both conceptual and factual knowledge questions correctly.
- Measurement and evaluation courses taught in undergraduate and graduate geography teaching programs should introduce the Revised Bloom's Taxonomy and use teaching activities for preparing questions according to this taxonomy.
- Geography teaching should incorporate activities relating to the knowledge and cognitive process levels whereby students can develop higher-order skills.
- Geography teachers from all levels of education should be given in-service training by measurement and evaluation experts in the properties of the Revised Bloom's Taxonomy and how to use the taxonomy to frame questions.
- As discussed in the literature review, questions prepared for geography exams in Turkey are generally rooted in the lower levels of the knowledge and cognitive process dimensions. Questions aimed at higher-order knowledge and cognitive process levels are scarce. Therefore, there is a clear need to use learning activities that promote higher-order thinking (i.e. learning activities aimed at the conceptual, procedural and metacognitive knowledge levels and the analyse, evaluate and create cognitive processes).

6. Conclusion

The aim of the study was to explore whether there is a relationship between students' answers to geography questions framed according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy. The Kolmogorov-Smirnov test was performed to decide which parametric or nonparametric tests would be used to test the research hypothesis. The p-value was less than .05 for all variables, thereby indicating that the data were not normally distributed. Therefore, the study employed nonparametric chi-square goodness of fit test and chi-square test of independence to test the research hypotheses. The reliability of the measurement instrument was tested using the Pearson product-moment correlation coefficient (PPMCC) and found to be .82. Prior to the analysis of the data using nonparametric tests, the frequency and percentage distributions of students' answers to the factual and conceptual knowledge questions were determined. The rate of those who answered the factual knowledge questions correctly ranged from the lowest percentage of 51.9% to the highest percentage of 100%. The rate of those who answered the conceptual knowledge questions correctly ranged from the lowest percentage of 5.8% to the highest percentage of 78.8% (Table 3, Figure 1). The results of the Chi-Square goodness of fit test run to test whether students' answers differ in the factual and conceptual knowledge levels showed a statistically significant difference between the observed and expected values [X^2 (1, n = 447) = .0, p = .00].

The results of the chi-square test of independence revealed a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions [X^2(1, n = 447), p = .00, Cramer's V = .24 (Table 6)].

Accordingly,

1) All expected cell sizes were greater than 5 (in this study, greater than 18.19). Thus, one of the assumptions of chi-square that the minimum expected cell frequency should be 5 or greater was not violated (Table 5).
2) The Adjusted Residual value, which helps determine the differences between groups, ranged from -3.1 to 3.0 in the factual knowledge questions and from -2.6 to 3.1 in the conceptual knowledge questions. These figures indicate that the number of participants is sufficient.
3) The Pearson Chi-Square value was found to be 25.829. The degree of freedom (df) is 6. The level of significance of this value is .00 (Table 5). The Sig. value must be 05 or smaller for statistical significance. Because the value of .00 is smaller than the alpha value of .05, it means that there is a significant relationship between students' answers to the factual knowledge questions and those to the conceptual knowledge questions.
4) The effect size of the study was found to be .240 (Table 7). This coefficient represents a medium-size effect according to Cohen's criteria (1988, pp. 5-11). The effect size coefficient (Table 7) shows that there is a moderate correlation between the students' answers to the factual knowledge questions and those to the conceptual knowledge questions.

It is hoped that this study will contribute to further research. There is room for further research on the preparation, analysis and evaluation of questions for the geography course according to the cognitive process and knowledge dimensions of the Revised Bloom's Taxonomy.

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Appendix 1. Questions prepared and directed at students according to the factual and conceptual levels of the knowledge dimension of the Revised Bloom's Taxonomy

Select the correct answer for the following multiple-choice questions:

Question 1: It is the age of the person in the middle of the list when the age distribution of a population is listed in order from the youngest to the oldest?
Which of the following concepts does this statement define?

a) Total-age-dependency ratio;
b) Crude birth rate;
c) Active population;
d) Median age;
e) Life expectancy.

Answer: d

Question 1: Which of the following defines the number of people aged 0 to 14 and 65 years and over compared to the total population aged 15 to 64?

a) Total-age-dependency ratio;
b) Young-age dependency ratio;
c) Population growth rate;
d) Demographic transition;
e) Old-age dependency ratio.

Answer: a

Question 3: Which of the following is not an economic factor affecting settlement?

a) Grazing;
b) Business;
c) Trade;
d) Agriculture;
e) Agricultural methods.

Answer: e

Question 4: Which of the following defines the position or site occupied by a city and its surrounding area?

a) Site;
b) Location;
c) Megapolis;
d) Arterial road;
e) Recreation.

Answer: b

Question 5: Which of the following is not internal migration?

a) Countryside to cities;
b) Developed country to underdeveloped country;
c) Countryside to countryside;
d) Cities to cities;
e) Cities to the countryside.

Answer: b

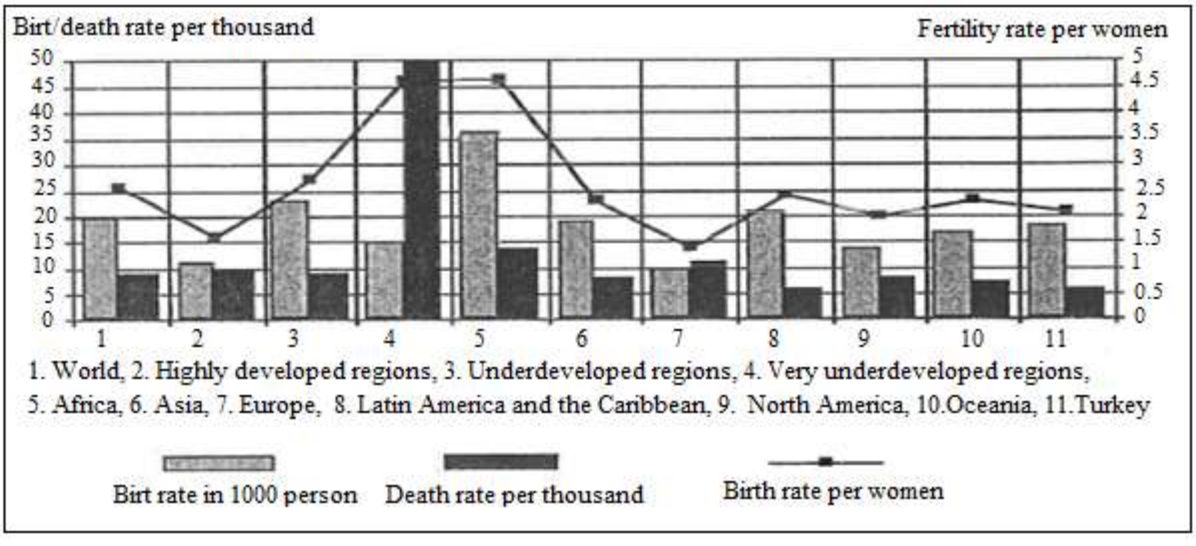
Question 6: Write down the factors that play a role in population change.
Answer:

a) Birth-death ratio,
b) Emigration and immigration,
c) Epidemics and infectious diseases,
d) Natural disasters such as earthquakes, floods, and tsunamis play a role in population change.

Question 7: Describe dispersed and collective rural settlements:
Answer:

a) Dispersed settlement refers to a settlement pattern in which single or multiple houses are scattered across a particular area.
b) Collective settlement refers to a settlement pattern in which houses are close together and clustered around a central point.

Question 8: The following chart (Atalay, 201, p. 8) demonstrates fertility rates per woman by regions and continents in 2009. Given only the information in the chart, which of the following forecasts can be made?



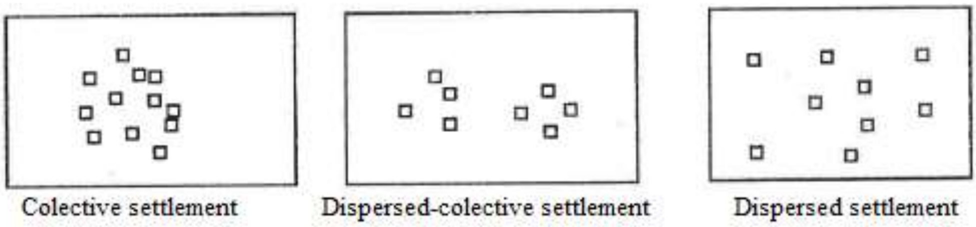
a) The lowest birth rate per woman will occur on the North American continent.
b) The greatest population growth will occur in highly developed regions.
c) The highest birth rate per woman will occur on the African continent.
d) The lowest population growth will occur on the Oceania continent.
e) The death rate per 1000 people will be lower in very undeveloped regions than in highly developed regions.

Answer: c

Question 9. Which of the followings is not directly related to migration?
a) Tourism;
b) Settlement type;
c) Transhumance;
d) Volcanic activities;
e) Religious and political factors.

Answer: b

Question 10. The images below (Atalay, 2011, p. 50) demonstrate rural settlement patters. Accordingly, which of the following is incorrect in reference to the images?



A) Image 1 demonstrates a collective rural settlement pattern.
a) mage 2 demonstrates a dispersed-collective rural settlement pattern.
b) The settlement pattern in Image 3 is seen in gentle slope areas.
c) The settlement pattern in Image 1 is seen in semi-arid regions with scarce water resources.
d) The settlement pattern in Image 2 is seen in defective areas with scarce agricultural land.

Answer: c

Question 11: Which of the following describes the relationship between elevation and city locations correctly?
a) Cities are generally located at an elevation of over 1000 metres in the torrid zone and under 1000 meters at the Northern and Southern latitudes.
b) Globally, cities are generally more densely set across coasts lying between 70 degrees north latitude and 59 degrees south latitude where there are hot water flows.

c) Cities in high plateaus and mountainous areas on the Asian continent are set at an elevation of under 1500 metres.
d) Large cities at the middle latitudes are positioned at an elevation of over 1500 metres.
e) High-elevation areas in hot and humid tropical areas are not convenient for the establishment of cities.

Answer: a

Question 12: Which of the following is used in the genetic and morphological classification of cities?
I. Classification of cities according to chronological periods from the beginning of historical origin or urbanization movements.
II. Classification of cities according to their population as small, medium, and large.
III. Classification of cities according to the stages of development (such as village, town, city, and metropolis), as in the development of living beings.
IV. Classification of cities according to different physical characteristics depending on the significant control of the topography in which cities are located.
V. Classification of cities according to their functions

a) II, III-V;
b) III-V;
c) I, V;
d) I-IV;
e) II-V.

Answer: b

Question 13: Explain and exemplify why arithmetic population density does not represent a real population distribution anywhere?
a) This is because this value takes into account less densely populated places and non-populated places of a country or a certain area.
b) For example, areas at an elevation of 1000 metres in western Anatolia and 2000 metres in eastern Anatolia often have no permanent settlement and, by extension, no population; however, arithmetic population density means as if they had populations.
c) Arithmetic population density is used to compare population densities of countries and have an idea about this.

Answer: Arithmetic population density does not indicate a real population distribution anywhere as seen in a, b and c.

Question 14: Explain and exemplify the relationship between topography and physical classification of cities.
a) Circular cities are set on a plain, e.g. Konya and Adana.

b) Cities that run in a linear direction are situated across a coastline between hillsides and a plain, e.g. Trabzon, Rize, and Giresun.
c) Cities set in a valley and on valley slopes have clusters of separate districts, e.g. Artvin.

Answer: Cities are classified according to different physical characteristics, as seen in a, b and c, depending on the significant control of the topography in which they are located.